Feasibility Study

I-40/SR 1734/SR 1826 (Exit 111) Interchange Reconstruction

Valdese Burke County

Division 13 FS-0213C



Feasibility Studies Unit Program Development Branch Division of Highways N.C. Department of Transportation

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FS-0213C complete the will be added to

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I. General Description

This feasibility study addresses the proposed interchange improvements to I-40/SR 1734/SR 1826 (Exit 111) near the Town of Valdese in Burke County. The proposed improvements include reconstructing the interchange to current design standards.

The existing interchange includes a bridge carrying Carolina Street (SR 1734) traffic over I-40. Carolina Street ends at an intersection with Flat Gap Road (SR 1737) and Millstone Avenue (SR 1734) just south of the bridge. The I-40 eastbound on- and off-ramps, as well as the westbound off-ramp connect to secondary roadways via short ramps. Eastbound I-40 traffic is routed back to Carolina Avenue by Millstone Avenue, and exiting westbound I-40 traffic is routed to Carolina Avenue by Abees Grove Church Road (SR 1826). The on-ramp for westbound I-40 traffic is a conventional ramp connected directly to Carolina Avenue. The project study area is shown in Figure 1.

Three compressed diamond interchange configurations have been evaluated for this Feasibility Study (Alternatives A, B, and C). All three involve realignments of Carolina Street, Flat Gap Road, and Millstone Avenue. Carolina Street will be designed as a 36-foot, two-lane curb and gutter roadway in the area of the interchange. The ramps and secondary roadways will use current design standards. The bridge for each alternative will be a two-lane bridge with sidewalks on each side, designed to span six travel lanes and a 46-foot wide median. Full control of access is proposed within the interchange and along most of Carolina Street from just north of Abees Grove Church Road to Flat Gap Road and Millstone Avenue (see Figures 2-4).

This study is the initial step in the planning and design process for this project and is not the product of exhaustive environmental or design investigations. The purpose of this study is to describe the proposed project, including costs, and to identify potential problems that may require consideration in the planning and design phases.

II. Background and Need for Project

The purpose of this project is to reconstruct Exit 111 to meet current NCDOT design standards and provide improved traffic safety and operations. The current interchange configuration is poor with short deceleration/acceleration lanes and a sharp curve on the

eastbound off-ramp, as well as unconventional ramps which utilize secondary roads to provide access between Carolina Street and I-40. Also, the existing I-40 ramp junctions at Exit 111 are approximately 1,700 feet from Exit 112 ramps. Current design standards propose a minimum spacing of one mile in urban areas and three miles in rural areas. A compressed diamond interchange will allow motorists the time and space to accelerate to interstate speed or slow to secondary roadway speeds. A reconfiguration of Exit 111 will enhance the safety of local users by giving exiting I-40 traffic the opportunity to slow to posted speed limits. It will also enhance the safety of the traveling public on I-40 by reducing the need for motorists to decelerate to unsafe speeds on the interstate before exiting.

Carolina Street and Abees Grove Church Road are classified as major thoroughfares in the latest Valdese-Rutherford College-Connelly Springs Thoroughfare Plan (adopted June 7, 1999) and as major collectors in the North Carolina Functional Classification System. Flat Gap Road is classified as a minor thoroughfare in the Valdese-Rutherford College-Connelly Springs Thoroughfare Plan and is not classified in the North Carolina Functional Classification System.

Town of Valdese, Burke County, and Unifour Rural Planning Organization (RPO) officials support this project. The conclusions of the Unifour RPO's *I-40 Corridor Study* (adopted December 2003) ranked improvements to Exit 111 in Burke County as the number one priority need. In response for requests for comments on this project the Town Mañager for Valdese, the Burke County Planning Director, and an official from the Unifour RPO expressed support for FS-0213C in April 2005.

I-40 is a four-lane, median divided facility at this location with a posted speed limit of 70 mph. The interchange ramps all have one lane, and the adjacent secondary roadways are two lanes with posted speed limits ranging from 35 mph along Carolina Street to 55 mph along Flat Gap Road. The existing right of way width is approximately 60 feet along Carolina Street and the other adjacent secondary roadways, and approximately 260 feet along I-40. The existing bridge (Bridge No. 147) was built in 1955 and is a 184-foot long, 34-foot wide concrete structure with steel I-beams. It carries two lanes over I-40, has three-foot sidewalks on both sides, and a minimum vertical clearance of 14 feet. According to the most recent inspection report (December 2005), the bridge has a sufficiency rating of 66.8 and is "functionally obsolete."

Based on site visit observations, existing land uses adjacent to Exit 111 include primarily vacant and undeveloped properties. Some residential uses may be found along Barus Street (SR 1812), Flat Gap Road, Millstone Avenue, Abees Grove Church Road, and Mourglea Avenue. Further away from the interchange, Carolina Street, which connects Exit 111 to the downtown area of Valdese, serves residential land uses that become increasingly denser towards the center of the Town. According to a map depicting land uses in the *I-40 Corridor Study*, land uses surrounding Exit 111 are mostly residential with some commercial and office/institutional uses north of the interchange. This map also shows the land uses south of Abees Grove Church Road between Exit 111 and Exit 112 as transitional.

There are no programmed projects in the 2007-2013 Draft State Transportation Improvement Program (TIP) in the general vicinity of this project that would affect the alternatives developed for this study.

III. Traffic and Safety

According to estimates by the NCDOT Transportation Planning Branch, current (2006) average annual traffic volumes reach 5,600 vehicles per day (vpd) on Carolina Street and 50,300 vpd on I-40. By the year 2035, these volumes are expected to reach 10,400 vpd on Carolina Street and 97,600 vpd on I-40. Trucks are estimated to represent 5% of the Carolina Street traffic and 20% of the I-40 traffic. Table 1 summarizes the traffic information on other local roads within the project area.

Table 1: Traffic Data for Roads in the Project Area

Location	2006 Traffic (vehicles/ day)	2035 Traffic (vehicles/ day)	% Trucks	
Carolina Street	5,600	10,400	5%	
I-40	50,300	97,600	20%	
Flat Gap Road	2,000	3,600	3%	
Abees Grove Church Road	500	800	3%	
Carolina Street / Millstone Avenue	500	800	3%	

Highway capacity analyses were performed for the years 2006 and 2035 to evaluate existing and future traffic operations in the proposed interchange area. The Highway Capacity Manual Software (HCM 2000 Release 4.1) was used to analyze all roadway segments, ramp merge and diverge areas, and stop-sign controlled intersections. Synchro 5.0 and SimTraffic were used to analyze and simulate all signalized intersections.

Existing Traffic Conditions and No-Build Alternative

The capacity analyses of the unsignalized intersections and ramp junctions were performed for the existing conditions in 2006 and the no-build alternative in 2035. All the ramp junctions are currently functioning at Level of Service C (LOS C) in 2006, and without any improvements the ramp junctions will function at LOS D in 2035.

There are four un-signalized intersections for the existing conditions:

- 1. Carolina Street and Flat Gap Road
- 2. Carolina Street and I-40 eastbound on-ramp
- 3. Abees Grove Church Road and I-40 westbound off-ramp
- 4. Carolina Street and Abees Grove Church Road

The intersections are functioning at levels of service B, B, A, and B, respectively, in 2006, for the critical approaches to the intersections. They will function at LOS C, C, B and D, respectively, in 2035. See Table 2 for details.

Table 2: Summary of 2006 and 2035 Year Levels of Service

	2006 Existing LOS	2035 No-Build LOS	2035 Build LOS		
Signalized Intersections			Alt. A	Alt. B	Alt. C
Northern Ramp Terminal	n/a	n/a	C	С	С
Southern Ramp Terminal	n/a	n/a	В	В	В
Ramp Junctions					
Eastbound On-Ramp	С	D	D	D	D
Eastbound Off-Ramp	С	D	С	C	С
Westbound On-Ramp	С	D	D	D	D
Westbound Off-Ramp	С	D	D	D	D
Un-signalized Intersections					2500 - 12 - 2500 Carlos - 25 - 2500 - 2500 - 2500 - 2500 - 2500 - 2500 - 2500 - 2500 - 2500 - 2500 - 2500 - 2500 - 2500 - 2500
Carolina Street / Flat Gap Road	В	С	В	n/a	В
Carolina Street / I-40 Eastbound On-Ramp	В	C	n/a	n/a	n/a
Abees Grove Church Road / I-40 Westbound				-	
Off-Ramp	A	В	n/a	n/a	n/a
Carolina Street / Abees Grove Church Road	В	D	A A	n/a	n/a
Roundabouts					
Northern Ramp Terminal	n/a	n/a	n/a	A	n/a
Southern Ramp Terminal	n/a	n/a	n/a	A	n/a

Notes: n/a = Not Applicable

Alternatives A and C

Both Alternatives A and C provide a compressed diamond interchange with traditional intersections at the ramp terminals, and a realigned intersection with Flat Gap Road. Given the close proximity of Abees Grove Church Road to the northern ramps, Alternative A proposes right-in / right-out access at this intersection. Alternative C proposes to eliminate access between Carolina Street and Abees Grove Church Road. Since Alternatives A and C have the same interchange layouts and traffic volumes, the results of the analyses for both alternatives are identical and are discussed together. The

intersection of Carolina Street and Abees Grove Church Road, which only applies to Alternative A, is discussed separately.

The signalized intersection at the northern ramp terminal of the interchange will function at LOS C for the AM traffic peak and at LOS B for the PM peak in 2035. At the southern ramp terminal, the signalized intersection will function at LOS B in the AM peak and LOS A in the PM peak.

The ramp-freeway junction with the highest volume of traffic merging onto I-40 (AM peak at the on-ramp for I-40 eastbound) will function at a LOS D as a one-lane ramp onto the future six-lane freeway. The ramp-freeway junction with the highest volume of exiting traffic (AM peak at the off-ramp for I-40 westbound) will function at a LOS D as a one-lane ramp from the future six-lane freeway. All other ramp junction merge and diverge areas will function at LOS C or LOS D. See Table 2 for details.

The unsignalized intersection at Carolina Street and Flat Gap Road with two-way stop control at Flat Gap Road will function at LOS B for the southbound approach in 2035. For Alternative A, the intersection at Carolina Street and Abees Grove Church Road with one-way stop control at Abees Grove Church Road will function at LOS A for the southbound approach.

Alternative B

The capacity analysis for Alternative B with roundabouts at the ramp terminals was performed by the Congestion Management Section of NCDOT. The northern four-leg roundabout was analyzed as a one-lane roundabout with one-lane approaches. The southern most five-leg roundabout was analyzed as a one-lane roundabout with one-lane approach. The analysis for each roundabout was based on an inscribed roundabout diameter of 120 feet, which provides for a circulatory roadway width of 16 feet and a center island diameter of 88 feet. The approach speed was assumed to be 25 miles per hour. Based on this information, both roundabouts will adequately service the projected traffic and are expected to operate at an overall LOS A in the year 2035. This analysis was based upon traffic operations only. Additional analysis and design will be needed in later planning and design stages.

A third roundabout is also proposed at Abees Grove Church Road. A specific roundabout analysis was not performed for this location; however, given the similar traffic volumes, this roundabout is also expected to operate at an acceptable LOS in the design year.

Crash Analysis

Between July 1, 2003 and June 30, 2006 there were 12 reported crashes at Exit 111 – zero fatal, five non-fatal, and seven property damage only crashes. The crash rate is 49.04 crashes per 100 million vehicle miles traveled, which is well below the

2003-2005 statewide crash rate of 370.44 crashes per 100 million vehicle miles traveled for rural two-lane secondary routes.

IV. Description of Alternatives

Three compressed diamond interchange alternatives have been evaluated for this Feasibility Study (Alternatives A, B, and C). All three involve realignments of Carolina Street, Flat Gap Road, and Millstone Avenue. Carolina Street will be designed as a 36-foot, two-lane roadway with curbs and gutters in the area of the interchange. The ramps and secondary roadways will use current design standards. The bridge for each alternative will have two travel lanes with sidewalks on each side and will be designed to span six travel lanes and a 46-foot wide median. Full control of access is proposed within the interchange and along most of Carolina Street from just north of Abees Grove Church Road to Flat Gap Road and Millstone Avenue (see Figures 2-4).

Alternative A provides a compressed diamond interchange with Carolina Street approximately 700 feet west of the existing I-40 crossing – offering additional separation between Exits 111 and 112 (see Figure 2). Traditional intersections with traffic signals are proposed at the ramp terminals. Flat Gap Road and Millstone Avenue will be realigned to intersect Carolina Street approximately 500 feet south of the proposed eastbound I-40 ramps. Abees Grove Church Road and Mourglea Avenue will be realigned to intersect approximately 400 feet north of the proposed westbound I-40 ramps. Retaining walls may be required along both westbound I-40 ramps to minimize impacts along Abees Grove Church Road and Mourglea Avenue.

It is anticipated Alternative A will require 17 residential relocations and no business relocations. The total cost, including construction and right of way, is estimated to be \$21,200,000 (see the Alternatives Comparison Table).

Alternative B provides a compressed diamond interchange with Carolina Street approximately 700 feet west of the existing I-40 crossing – offering additional separation between Exits 111 and 112 (see Figure 3). Roundabouts are proposed at the ramp terminals. The southern roundabout will include realigned Flat Gap Road and Millstone Avenue. Abees Grove Church Road and Mourglea Avenue will be realigned to intersect at a third roundabout along Carolina Street approximately 400 feet north of the proposed westbound I-40 ramps. Retaining walls may be required along both westbound I-40 ramps to minimize impacts along Abees Grove Church Road and Mourglea Avenue.

It is anticipated Alternative B will require 18 residential relocations and no business relocations. The total cost, including construction and right of way, is estimated to be \$22,100,000 (see the Alternatives Comparison Table).

Alternative C provides a compressed diamond interchange with Carolina Street at the approximate location of the existing I-40 crossing and maintains the current spacing between Exits 111 and 112 (see Figure 4). Traditional intersections with traffic signals are proposed at the ramp terminals, and a portion of Carolina Street north of I-40 will be

realigned. Flat Gap Road and Millstone Avenue will be realigned to intersect Carolina Street approximately 550 feet south of the proposed eastbound I-40 ramps. Mourglea Avenue will be extended to the intersection of the realigned Carolina Street approximately 900 feet north of the proposed westbound I-40 ramps. A cul-de-sac is proposed along Abees Grove Church Road, cutting off access between Abees Grove Church Road and Carolina Street.

It is anticipated that Alternative C will require 8 residential relocations and no business relocations. The total cost, including construction and right of way, is estimated to be \$18,700,000 (see the Alternatives Comparison Table).

Table 3: Comparison of Alternatives

	Alternative A	Alternative B (Recommended)	Alternative C
Relocations			March State State And Co.
Residential	17	18	8
Business	0	0	0
Total	17	18	8
Cost Estimates			
Construction	\$17,800,000	\$18,600,000	\$15,700,000
Right of Way	\$ 3,400,000	\$ 3,500,000	\$ 3,000,000
Total	\$21,200,000	\$22,100,000	\$18,700,000

Alternatives A and B have more than twice the number of relocations than Alternative C due to the work proposed along the entire length of Mourglea Avenue. Alternatives A and B require the westbound I-40 on-ramp to be in close proximity to Mourglea Avenue, prompting the possible need for a retaining wall to minimize impacts along Mourglea Avenue. The proposed limits of construction along Mourglea Avenue do not extend the entire length in Alternative C.

Other design concepts considered during this studied but not investigated further include:

- Closing Exit 111 since Exit 112 is less than one mile away;
- Designing the interchange as a compressed diamond south of I-40 while providing more standard separation between the bridge and ramp terminals on the north side;
- A single point urban interchange (SPUI), and;
- Providing a loop in the northwest quadrant in lieu of a ramp for traffic exiting westbound I-40.

Exit 111 provides the main access to the Town of Valdese from I-40; therefore, closing this interchange is not feasible. Designing the interchange as a compressed diamond on the south side and a standard diamond interchange on the north side was not carried forward in this study. This concept would require a greater footprint and a realignment of Carolina Street which would result in more property impacts. A SPUI was eliminated

from consideration due to the high cost associated with the structure and is not considered appropriate for the existing rural character. A loop in the northwest quadrant would eliminate the need to relocate Abees Grove Church Road, but this concept would require the Carolina Street / Abees Grove Church Road intersection to be relocated further north to accommodate the loop terminal; thus, resulting in more property impacts. For this reason a design with a loop for exiting westbound I-40 traffic was not considered further.

V. Community Issues

- Based on current State Historic Preservation Office (SHPO) information, there are no National Register or State Study List sites located in the project vicinity.
- A review of the *Burke County Strategic Plan, 2002* gives no indication of potential environmental justice issues associated with this project, nor did site visit observations reveal any environmental justice issues.
- There are no schools, parks, recreation areas, or other public services that could be affected by this project.

VI. Natural Environment Issues

A detailed environmental study was not conducted for this feasibility study, however an environmental screening did find the following items which may need further evaluation in later planning and design stages:

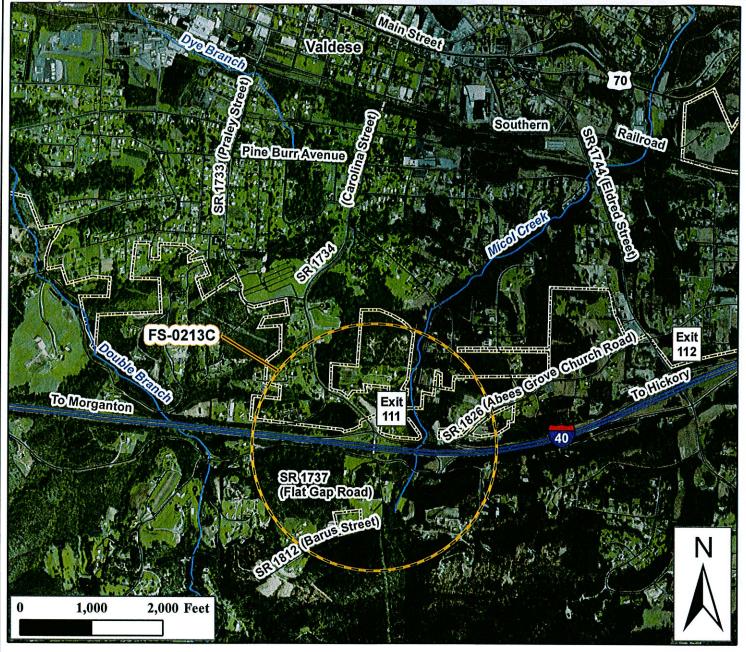
- Protected Species A search was conducted using the database from the North Carolina National Heritage Program for the Valdese quadrangle (updated January 2004). This search revealed two federally protected species – the Bog Turtle (threatened due to similarity of appearance) and the Dwarf-flowered Heartleaf (threatened). Sweet Pinesap was also listed as a "Federal Species of Concern."
- Wetlands Based on a search of the National Wetland Inventory using geographical information systems (GIS), there are no wetlands that will be affected by this project.
- Streams The proposed improvements include from one to three crossings of Micol Creek. In these areas, either new drainage structures or the extension of existing drainage structures will be required. Evaluation of structure type and sizing will be conducted at the project planning phase. Permits from the Army Corps of Engineers will likely need to be secured prior to construction.
- Hazardous Substance Disposal Areas / Superfund Sites Based on a search of GIS information supplied by NCDOT, there are no hazardous substance disposal areas / superfund sites in the project vicinity.

VII. Recommendations

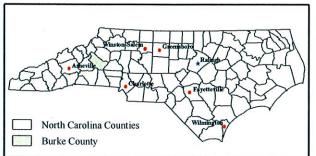
Alternative B, as described in Section IV, is the preferred alternative for this project. It is estimated to cost \$22,100,000 for right of way and construction. Alternative B provides a context sensitive design as the proposed roundabouts will enhance the appearance of the entrance to the Town of Valdese – creating an aesthetic gateway for the Town. This alternative will also minimize the structure width by eliminating the need for turn lanes on the bridge. The use of roundabouts will limit the number of intersections to three locations, will not require traffic signals, and will provide for free-flowing traffic. A traffic analysis found the roundabouts would operate at LOS A under future traffic projections. Alternative B has the highest cost and the highest number of relocations; however, the number of relocations may be reduced during future planning and design studies. As a more detailed design is developed, measures may be taken to lessen the affects along Mourglea Avenue, and thereby decrease the number of relocations.

Alternative A calls for Carolina Street to be realigned and extended on the south side of I-40 in order to provide adequate separation between the eastbound I-40 ramps and the intersection of Carolina Street, Flat Gap Road, and Millstone Avenue. Flat Gap Road and Millstone Avenue will also have to be realigned by as much as 600 feet south of the existing alignments. This alternative also creates four intersections within approximately 1,300 feet, which is undesirable. The intersections where the ramps terminate at Carolina Street will be signalized, thus requiring the width of the proposed bridge to be wide enough to accommodate a center lane for left turns at these intersections. For these reasons, Alternative A is not recommended.

While Alternative C has the lowest cost and the fewest number of relocations, this alternative requires four closely spaced intersections, does not increase the distance to Exit 112, will alter local traffic patterns, and will affect access to a local business. Similar to Alternative A, Alternative C also requires realignment and extension of Carolina Street and realignment of Flat Gap Road and Millstone Avenue. With this alternative, there will be four intersections within approximately 1,900 feet, which is also undesirable. Again, the ramp terminal intersections will be signalized requiring a center lane on the bridge for left turns. The proposed bridge will be constructed in approximately the same location as the existing bridge with the end of the proposed ramps on the eastern side of the interchange in approximately the same location as the existing ramps and loop. Therefore, this alternative will not increase the already short distance between Exit 111 and Exit 112. Furthermore, this alternative involves eliminating access to Carolina Street and Exit 111 from Abees Grove Church Road by constructing a cul-de-sac along Abees Grove Church Road. By doing so, local traffic patterns will be altered since access to Abees Grove Church Road will be limited to Eldred Street (SR 1744) at Exit 112. Access to an existing business located along Abees Grove Church Road at the current westbound I-40 exit ramp will also be adversely affected.









Project Vicinity Map FS-0213C

I-40 / SR 1734 / SR 1826 (Exit 111) Interchange Reconstruction Valdese, Burke County

FIGURE 1

